

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

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1. (Currently Amended) An image processing computer system for a photogrammetric analytical measurement[[,]] ~~in which camera parameters necessary for production of a survey map are determined based on~~ a picture having an image of a target, ~~said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed;~~ the target having at least three main reference point areas and at least one assistant reference point area, each of the main and assistant reference point areas being ~~formed as~~ a high luminance point area surrounded by a low luminance area, said computer system comprising:

*A1*  
a target-image extractor that extracts the image of ~~said the~~ target from ~~said the~~ picture, ~~by detecting high luminance point areas, each corresponding to one of~~ ~~based on~~ positional relationships between the main and assistant reference point areas of ~~said the~~ target;

an image processor that processes the extracted image of ~~said the~~ target to determine a two-dimensional position of each of ~~said the~~ main and assistant reference point areas of ~~said the~~ target with respect to a two-dimensional picture coordinate system defined on ~~said the~~ image;

a first calculator that calculates three-dimensional positions of said the main reference point areas with respect to a three-dimensional camera coordinate system defined on said a camera that photographs the picture;

a second calculator that calculates two-dimensional positions of said the main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image plane of said the camera, based on the three-dimensional positions of said the main reference point areas calculated by said first calculator; and

a third calculator that calculates camera parameters based on the two-dimensional positions of said the main reference point areas with respect to said the two-dimensional picture coordinate system and the two-dimensional positions of said the main reference point areas with respect to said the two-dimensional image-plane coordinate system, the camera parameters including a position and a direction of the camera when the picture is photographed.

2. (Currently Amended) An The image processing computer system as set forth in claim 1, further comprising:

a fourth calculator that calculates a three-dimensional position of said the assistant reference point area with respect to said the three-dimensional camera coordinate system based on the camera parameters calculated by said third calculator;

a fifth calculator that calculates a two-dimensional position of said the assistant reference point area with respect to said the two-dimensional image-plane coordinate system based on the three-dimensional position of said the assistant reference point area calculated by said fourth calculator; and

*A/*  
a determiner that determines whether the calculation of the camera parameters calculated by said third calculator is are correct or incorrect by comparing the two-dimensional position of the assistant reference point area obtained by said image processor with the two-dimensional position of said the assistant reference point area calculated by said fifth calculator.

3. (Currently Amended) An image processing method for a photogrammetric analytical measurement~~[,]~~ in which camera parameters necessary for production of a survey map are determined based on a picture having an image of a target, said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed, the target having at least three main reference point areas and at least one assistant reference point area, each of the main and assistant reference point areas being formed as a high luminance point area surrounded by a low luminance area, said method comprising steps of:

extracting the image of said the target from said the picture, by detecting high luminance point areas, each corresponding to one of based on positional relationships between the main and assistant reference point areas of said the target;

processing the extracted image of said the target to determine a two-dimensional position of each of said the main and assistant reference point areas of said the target with respect to a two-dimensional picture coordinate system defined on said target the image;

calculating three-dimensional positions of said the main reference point areas with respect to a three-dimensional camera coordinate system defined on said a camera that photographs the picture;

calculating two-dimensional positions of said the main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image plane of said the camera, based on the three-dimensional positions of said the main reference point areas; and

calculating camera parameters based on the two-dimensional positions of said the main reference point areas with respect to said the two-dimensional picture coordinate system and the two-dimensional positions of said the main reference point areas with respect to said the two-dimensional image-plane coordinate system, the camera parameters including a position and a direction of the camera when the picture is photographed.

4. (Currently Amended) ~~An~~ The image processing method as set forth in claim 3, further comprising:

calculating a three-dimensional position of said the assistant reference point area with respect to said the three-dimensional camera coordinate system based on the calculated camera parameters;

calculating a two-dimensional position of said the assistant reference point area with respect to said the two-dimensional image-plane coordinate system based on the calculated three-dimensional position of said the assistant reference point area; and

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determining whether ~~the calculation of~~ the camera parameters ~~is~~ are correct or incorrect by comparing the two-dimensional position ~~based on~~ said of the assistant reference point area with respect to the two-dimensional picture coordinate system with the two-dimensional position of said the assistant reference point area ~~based on~~ said with respect to the two-dimensional image-plane coordinate system.

5. (Currently Amended) A memory medium storing an image processing program for a photogrammetric analytical measurement~~[,]~~ using ~~in which~~ camera parameters necessary for production of a survey map are determined ~~based on~~ a picture having an image of a target, ~~said camera parameters representing a photographing position and a photographing direction of a camera, by which said picture is photographed;~~ the target having

at least three main reference point areas and at least one assistant reference point area, each of the main and assistant reference point areas being formed as a high luminance point area surrounded by a low luminance area, said program comprising steps of:

extracting the image of said the target from said the picture, by detecting high luminance point areas, each corresponding to one of based on positional relationships between the main and assistant reference point areas of said the target;

processing the extracted image of said the target to determine a two-dimensional position of each of said the main and assistant reference point areas of said the target with respect to a two-dimensional picture coordinate system defined on said target the image;

calculating three-dimensional positions of said the main reference point areas with respect to a three-dimensional camera coordinate system defined on said a camera that photographs the picture;

calculating two-dimensional positions of said the main reference point areas with respect to a two-dimensional image-plane coordinate system, defined on an image plane of said the camera, based on the three-dimensional positions of said the main reference point areas; and

calculating camera parameters based on the two-dimensional positions of said the main reference point areas with respect to said the two-dimensional picture coordinate system and the two-dimensional positions of said the main reference point areas with respect to said

the two-dimensional image-plane coordinate system, the camera parameters including a position and a direction of the camera when the picture is photographed.

6. (Currently Amended) A The memory medium as set forth in claims 5, wherein said program further comprises:

calculating a three-dimensional position of said the assistant reference point area with respect to said the three-dimensional camera coordinate system based on the calculated camera parameters;

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calculating a two-dimensional position of said the assistant reference point area with respect to said the two-dimensional image-plane coordinate system based on the calculated three-dimensional position of said the assistant reference point area; and

determining whether the calculation of the camera parameters is are correct or incorrect by comparing the two-dimensional position based on said of the assistant reference point area with respect to the two-dimensional picture coordinate system with the two-dimensional position of said the assistant reference point area based on said with respect to the two-dimensional image-plane coordinate system.